

# Community Based Solid Waste Management Through Public-Private-Community Partnerships: Experience of Waste Concern in Bangladesh


by

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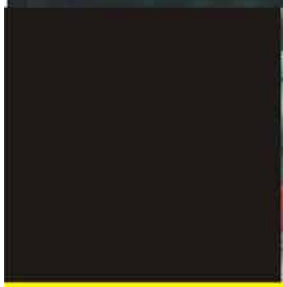
Deputy Director, Dept. of Environment



3R Asia Conference

Tokyo, Japan

October 30 to November 1, 2006













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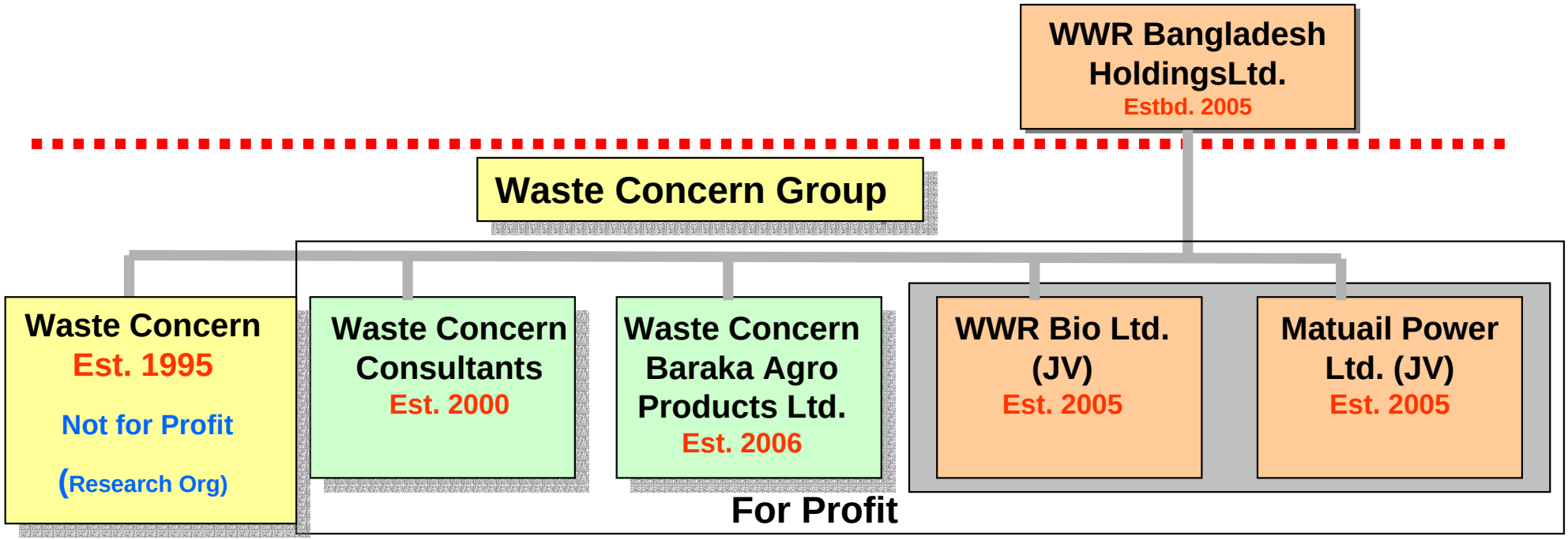
# Presentation Outline

I. Urbanization in Bangladesh
II. Solid Waste Management Situation in Bangladesh
III. Problems of Solid Waste Management in Urban Areas of Bangladesh
IV. Approach Followed by Waste Concern to Solve the Problems
V. How Solid Waste is Converted into Resource Through Public- Private-Community Partnerships (PPCP)
VI. Impact of the PPCP Model
VII. Lessons Learnt

WASTE CONCERN

# Brief Introduction of Waste Concern

- In 1995, Waste Concern, a national research organization was established in Bangladesh.
- **In 2005, Waste Concern Group** was formed as a Social Business Enterprise (SBE) comprising of a number of special purpose companies.
- Our main objective is to promote the idea of ***converting waste into resource.***

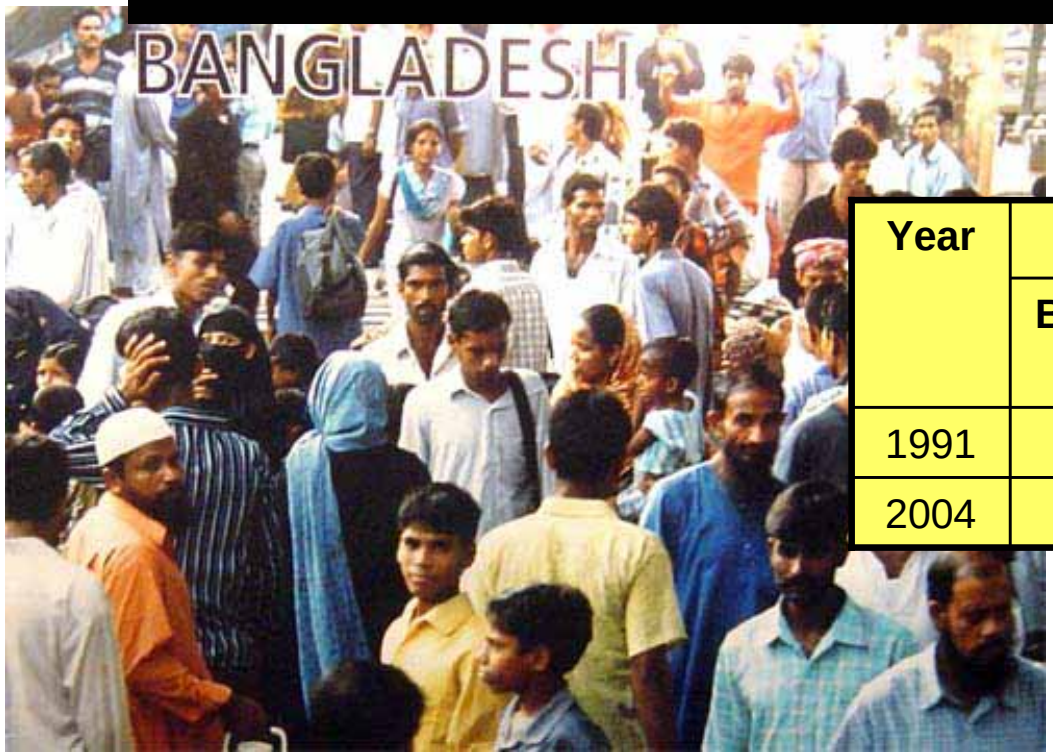



## Fields of Activity:

- ✓ Solid Waste Management and Resource Recovery
- ✓ Clinical & Hazardous Waste Management
- ✓ Policy on Waste Management
- ✓ Climate Change & Clean Development Mechanism
- ✓ Industrial Pollution Control
- ✓ EMS & ISO 14001
- ✓ Organic Farming
- ✓ Ecological Sanitation
- ✓ Renewable Energy



# Urbanization in Bangladesh




| Year | Urban Population Density/Sq.Km. | | |
|---|---|---|---|
| | Bangladesh Urban | Dhaka Mega City | Dhaka City Corporation Area |
| 1991 | 2179 | 4795 | 15333 |
| 2004 | 3008 | 8573 | 18055 |

| Year | Total Urban Population | Percent of Urban Population | Average Annual Growth Rate (%) |
|---|---|---|---|
| 1951 | 1819773 | 4.33 | 1.69 |
| 1961 | 2640726 | 5.19 | 3.75 |
| 1974 | 6273602 | 8.78 | 6.62 |
| 1981 | 13535963 | 15.54 | 10.63 |
| 1991 | 20872204 | 20.15 | 5.43 |
| 2001 | 28808477 | 23.39 | 3.27 |
| 2025* | 78440000 | 40.00 | - |

* source: UMP, Asia News, Summer, 1999

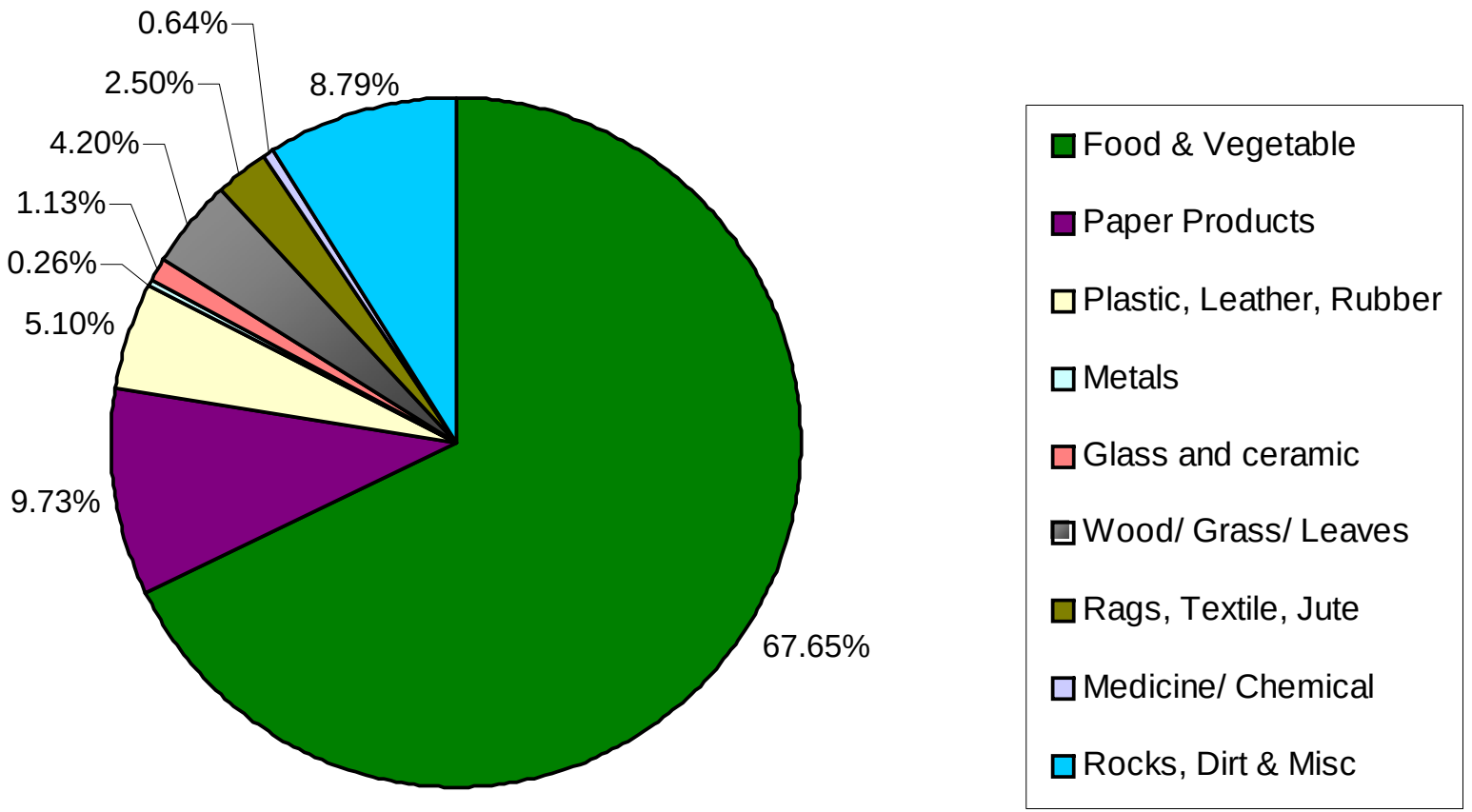
# Total Waste Generation in Urban Areas of Bangladesh in 2005

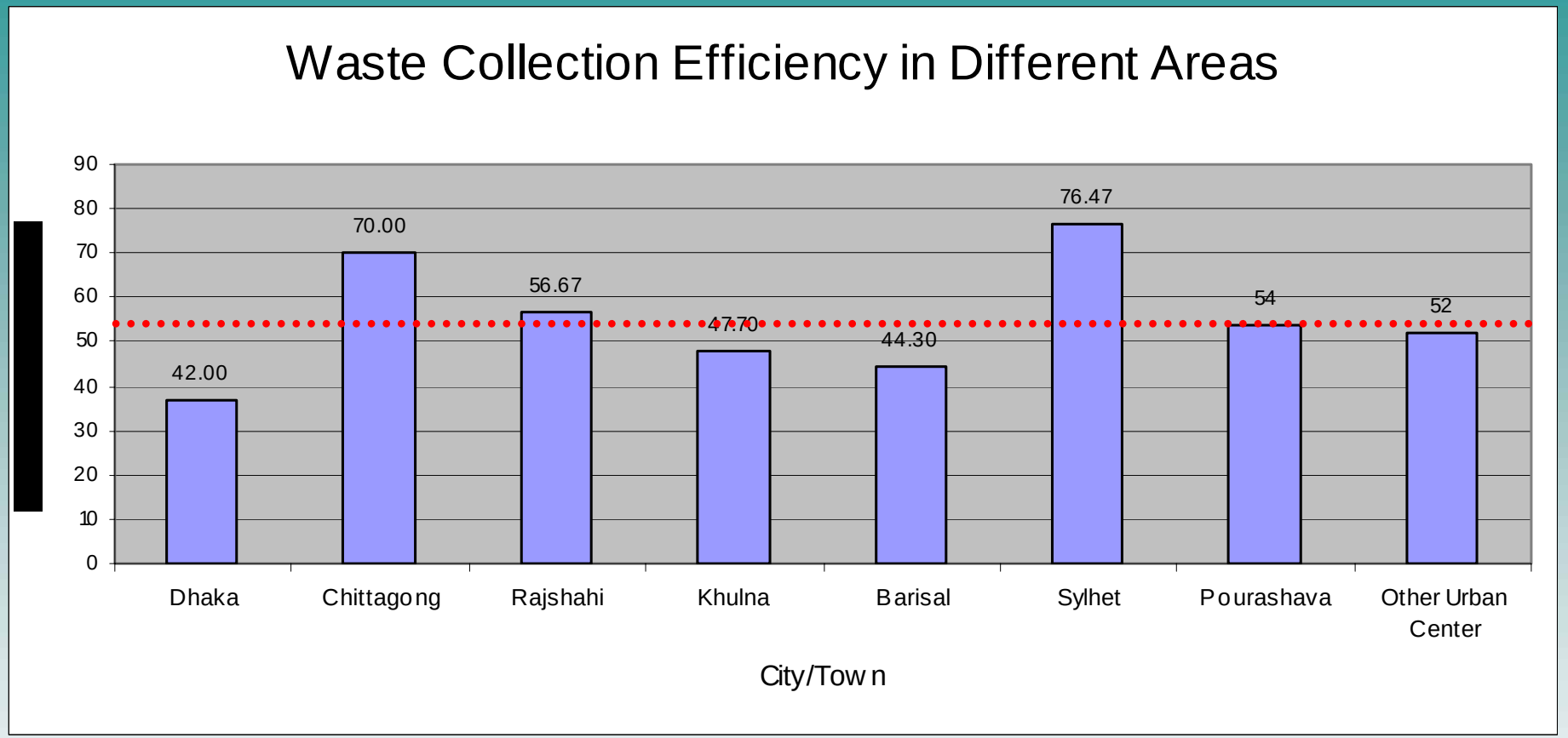
| City/Town | *WGR (kg/cap/day) | No. of City/Town | Total Population (2005) | Population** (2005) | TWG*** (Ton/day) | | Average TWG (Ton/day) |
|---|---|---|---|---|---|---|---|
| | | | | | Dry season | Wet season | |
| Dhaka | 0.56 | 1 | 6,116,731 | 6,728,404 | 3,767.91 | 5,501.14 | 4,634.52 |
| Chittagong | 0.48 | 1 | 2,383,725 | 2,622,098 | 1,258.61 | 1,837.57 | 1,548.09 |
| Rajshahi | 0.3 | 1 | 425,798 | 468,378 | 140.51 | 205.15 | 172.83 |
| Khulna | 0.27 | 1 | 879,422 | 967,365 | 261.19 | 381.34 | 321.26 |
| Barisal | 0.25 | 1 | 397,281 | 437,009 | 109.25 | 159.51 | 134.38 |
| Sylhet | 0.3 | 1 | 351,724 | 386,896 | 116.07 | 169.46 | 142.76 |
| Pourashavas | 0.25 | 298 | 13,831,187 | 15,214,306 | 3,803.58 | 5,553.22 | 4,678.40 |
| Other Urban Centers | 0.15 | 218 | 8,379,647 | 9,217,612 | 1,382.64 | 2,018.66 | 1,700.65 |
| **Total** | **-** | **522** | **32,765,516** | **36,042,067** | **10,839.75** | **15,826.04** | **13,332.89** |

*WGR= Waste Generation Rate,
** Including 10% increase for floating population,
***TWG= Total Waste Generation, which increases 46% in wet season from dry season
Source: 1 JICA (2004), 2 Chittagong City Corporation, 3 Field Survey, 4 Sinha (2000), 5 Field Survey, 6 Sylhet City Corporation, 7, 8 Field Survey

Average per capita urban waste generation rate is estimated as 0.41 kg/capita/day.

## Fig 1: Average Physical Composition of Urban Solid Waste




Waste Collection Efficiency in Different Areas
90
80
70
60
50
40
30
20
10
0
42.00
70.00
56.67
47.70
44.30
76.47
54
52
Dhaka
Chittagong
Rajshahi
Khulna
Barisal
Sylhet
Pourashava
Other Urban Center
City/Town

# RECYCLING INDUSTRIES IN DHAKA CITY



ALUMINIUM



PLASTIC



GLASS



PAPER



BONES



POLYTHENE

- **120,000** urban poor from the informal sector are involved in the recycling trade chain of Dhaka city

- **15%** of the total generated waste in Dhaka (mainly inorganic ) which amounts 475 tonnes/day are recycled daily.

# Informal Recycling of Inorganic Solid Waste and Savings through Recycling (in 2005)

| City/Town | TWG* (Ton/day) | No. of City/Town | % of Inorganic Waste Recycling** | Savings through recycling per year, (Tk. million) |
|---|---|---|---|---|
| Dhaka | 4,634.52 | 1 | 15.00 | 170.00 |
| Chittagong | 1,548.09 | 1 | 12.45 | 28.96 |
| Rajshahi | 172.83 | 1 | 6.7 | 1.00 |
| Khulna | 321.26 | 1 | 6.00 | 6.94 |
| Barisal | 134.38 | 1 | 5.42 | 5.14 |
| Sylhet | 142.76 | 1 | 4.23 | 3.44 |
| Pourashava | 4,678.40 | 298 | 3.89 | 8,862.52 |
| Other Urban Center | 1,700.65 | 218 | 4.00 | 1,627.50 |
| Total | 13,332.89 | 522 | - | 10,705.5 (15.29 million US $) |

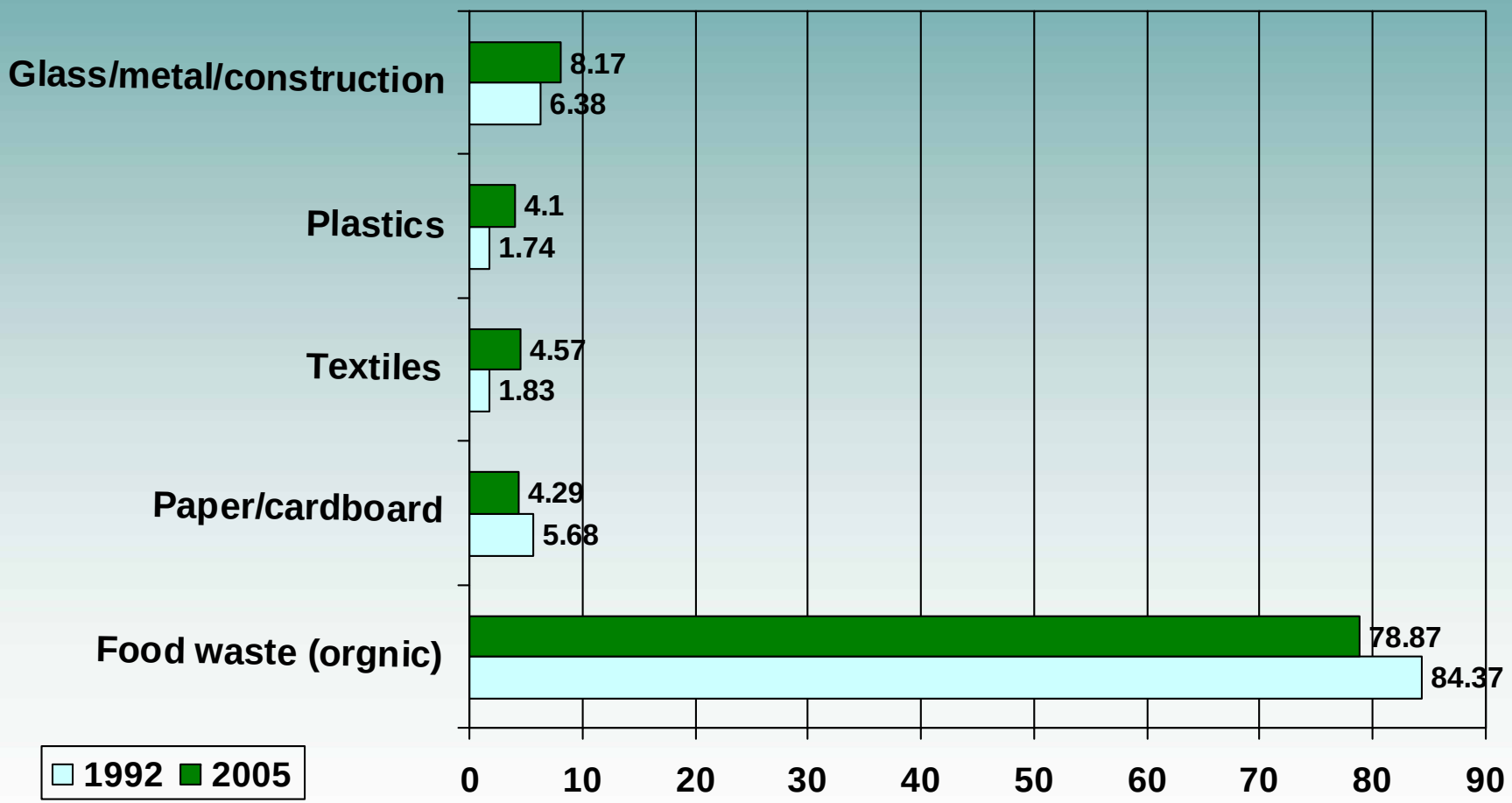
**1 US $ = BDT 70**

## Relationship of GDP & Population with Waste Generation

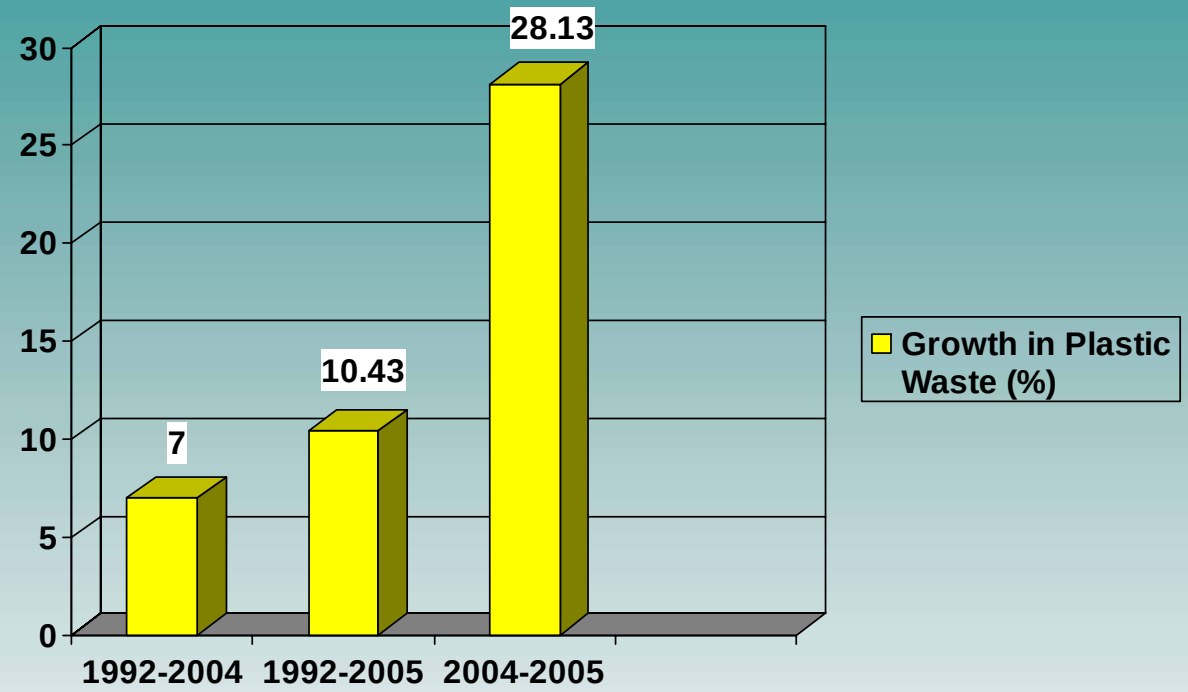
| Year | Urban Population | Total Urban Waste Generation (Ton/day) | Per Capita Waste Generation Rate in urban areas Kg/cap/day | Per Capita GDP |
|---|---|---|---|---|
| 1991 | 20.8 million | 6493 | 0.31* | US $ 220 |
| 2005 | 32.76 million | 13,330 | 0.41** | US $ 482**** |
| 2025 | 78.44 million | 47,000 | 0.60*** | - |

* World Bank, 1998, *** Waste Concern, 2005, *** UMP, 1999, **** GOB, 2006

# Comparative Analysis of Composition of Waste Dhaka City Between 1992 & 2005




Source: Ahmed, 1992 and Waste Concern 2005




| Comparison | 1992* (%) | 2004** | 2005*** |
|---|---|---|---|
| % of Plastic in DCC waste | 1.74 | 3.2 | 4.1 |

* BUET/World Bank
**JICA, 2004
*** Waste Concern, 2005

## Growth of Plastic Waste in DCC area

# WASTE GENERATION IS RAPIDLY INCREASING



# MAJOR PORTION OF THE WASTE IS ORGANIC



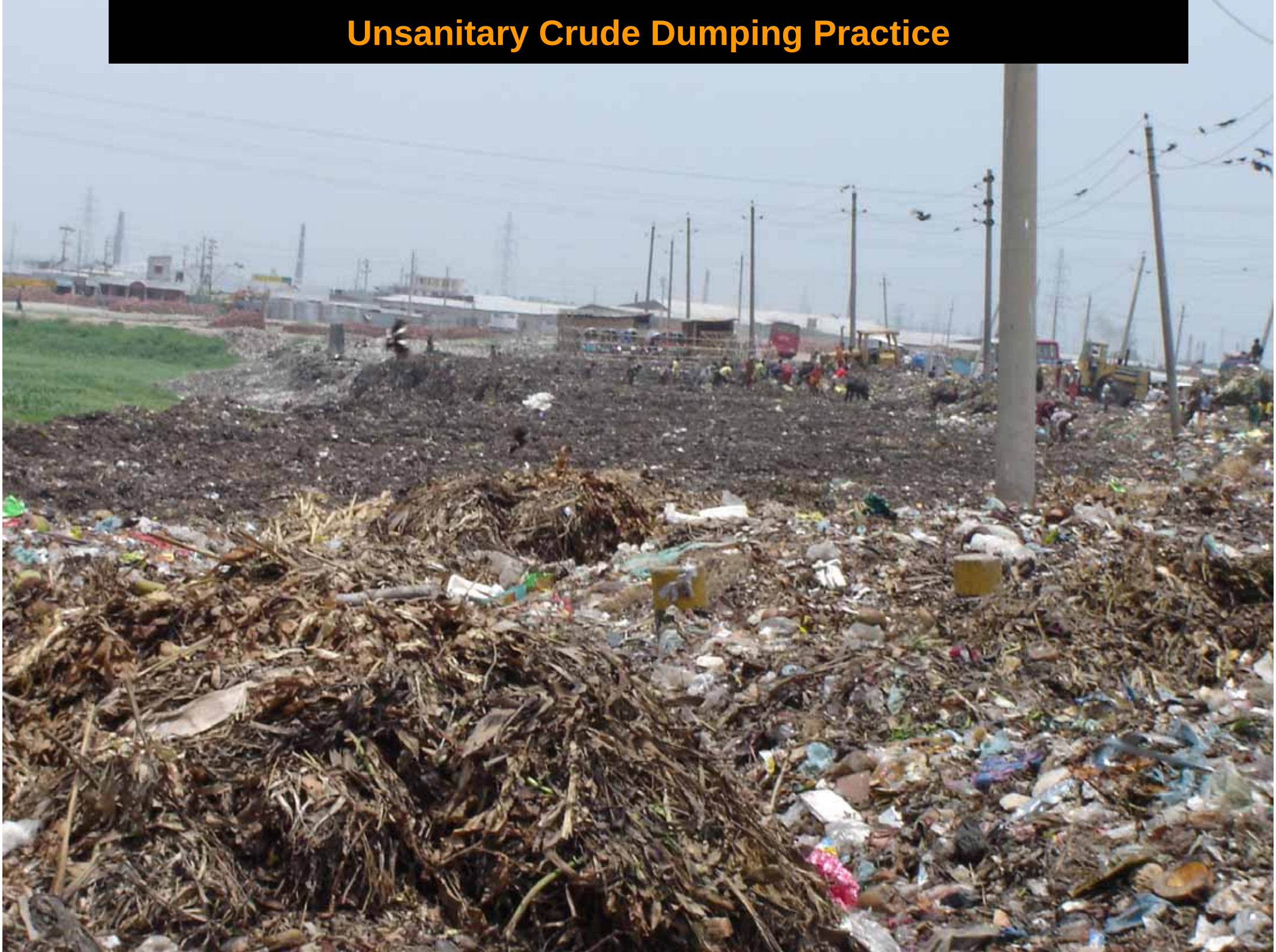
# Low-lying areas, drains and canals are clogged with waste



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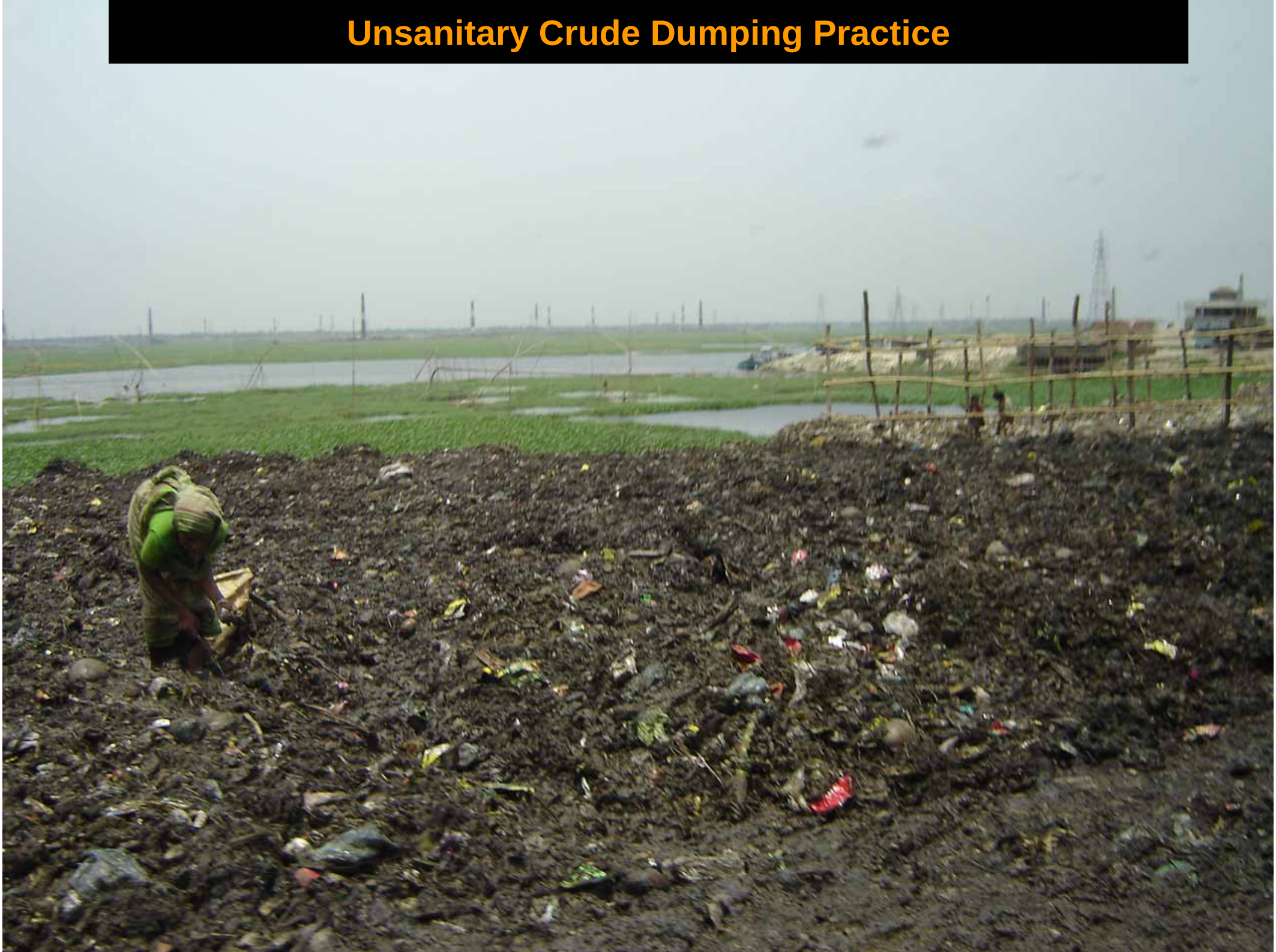
# Unsanitary Crude Dumping Practice



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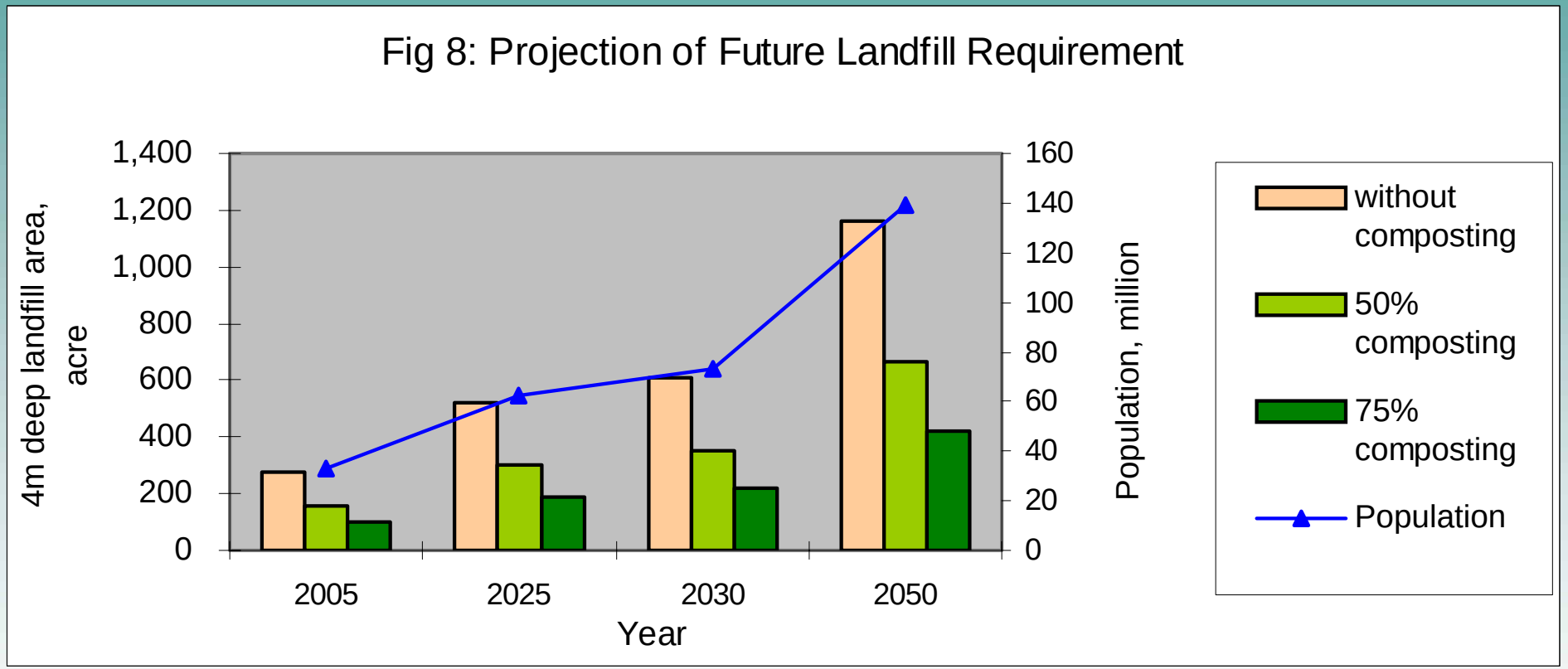


# Landfill Volume Requirement per Year for Urban Solid Waste Disposal

| City / Town | TWG* (Ton/day) | Waste Collection Rate, % | Landfill area required with 4m depth, acre per year | |
|---|---|---|---|---|
| | | | With existing collection efficiency | With 100% collection efficiency |
| Dhaka | 4,634.52 | 42.00 | 39.89 | 94.97 |
| Chittagong | 1,548.09 | 70.00 | 22.21 | 31.72 |
| Rajshahi | 172.83 | 56.67 | 2.01 | 3.54 |
| Khulna | 321.26 | 47.70 | 3.14 | 6.58 |
| Barisal | 134.38 | 44.30 | 1.22 | 2.75 |
| Sylhet | 142.76 | 76.47 | 2.24 | 2.93 |
| Pourashava | 4,678.40 | 54.42 | 52.17 | 95.87 |
| Urban Center | 1,700.65 | 52 | 18.12 | 34.85 |
| Total | 13,332.89 | - | 140.99 | 273.21 |

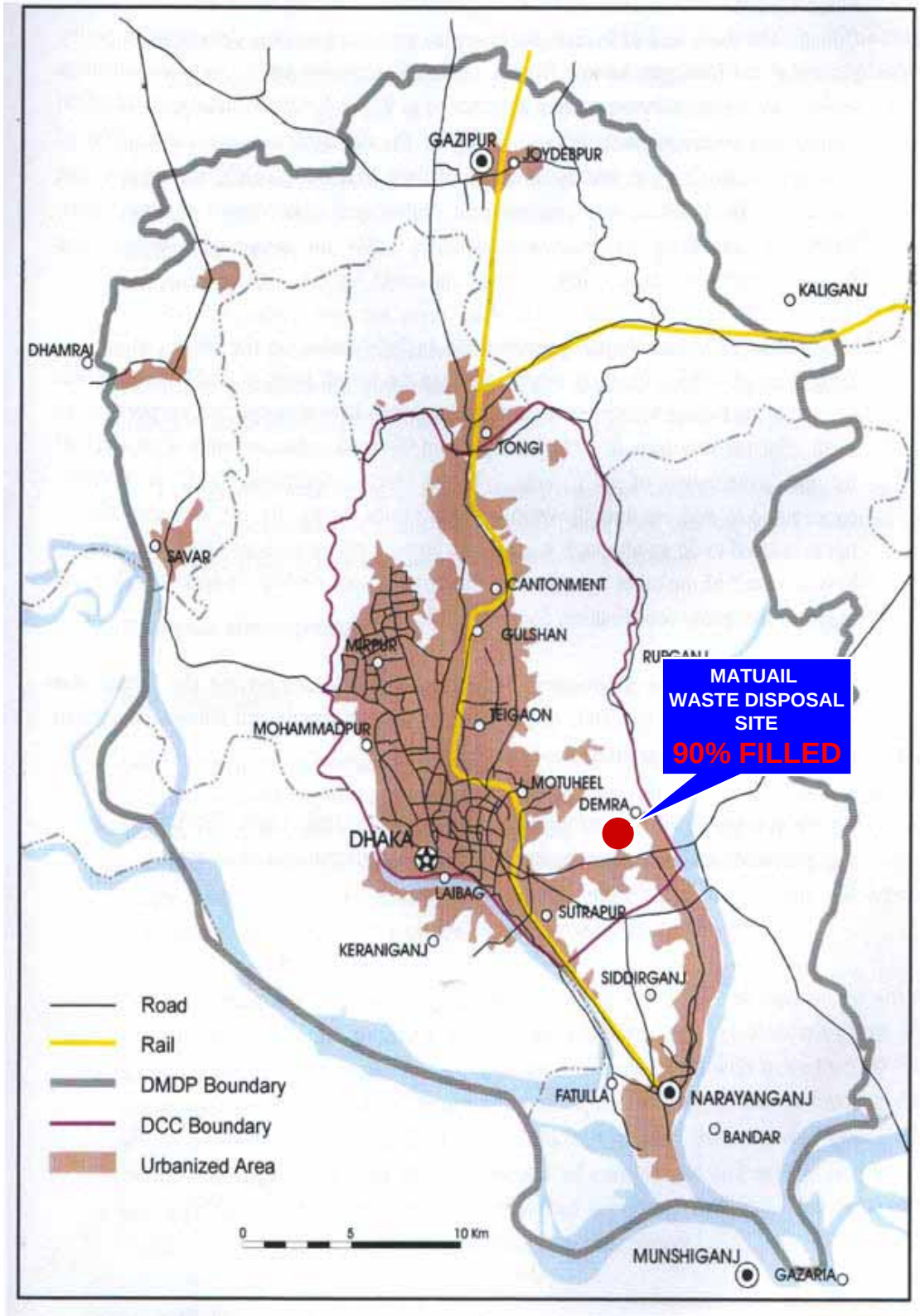
*TWG = Total Waste Generation

Fig 8: Projection of Future Landfill Requirement



# Green House Gas Emission Potential of Urban Solid Waste

| City/Town | TWG*, (Ton/day) | GHG emission potential, million ton $CO_2e$ / year |
|---|---|---|
| Dhaka | 4,634.52 | 0.76 |
| Chittagong | 1,548.09 | 0.25 |
| Rajshahi | 172.83 | 0.03 |
| Khulna | 321.26 | 0.05 |
| Barisal | 134.38 | 0.02 |
| Sylhet | 142.76 | 0.02 |
| Pourashava | 4,678.40 | 0.77 |
| Other Urban Center | 1,700.65 | 0.28 |
| **Total** | **13,332.89** | **2.19** |




# Demographic Profile of Dhaka Mega City

In terms of population Dhaka was the 11th biggest city in the year 2000 and will be the 4th largest city in world in 2015

- Total Population : 11.3 million ( 2004)
- Administrative Area : 1353 Sq. Km
- Population Growth Rate :4.33% (1991-2001)
- GDP (Per Capita) : US $ 500

**Dhaka City Map Showing the only official dumpsite (unsanitary) of the city which will be filled-up within a year.**

# Negative Impacts of Unmanaged Waste

**VERMINS**
***Spreading more than 40 Diseases***



**METHANE GAS**
***Bad Odor & Green House gas***

**LEACHATE**
***Polluting Ground & Surface Water***



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**PROBLEMS OF SOLID WASTE MANAGEMENT**

# PROBLEMS OF SOLID WASTE MANAGEMENT

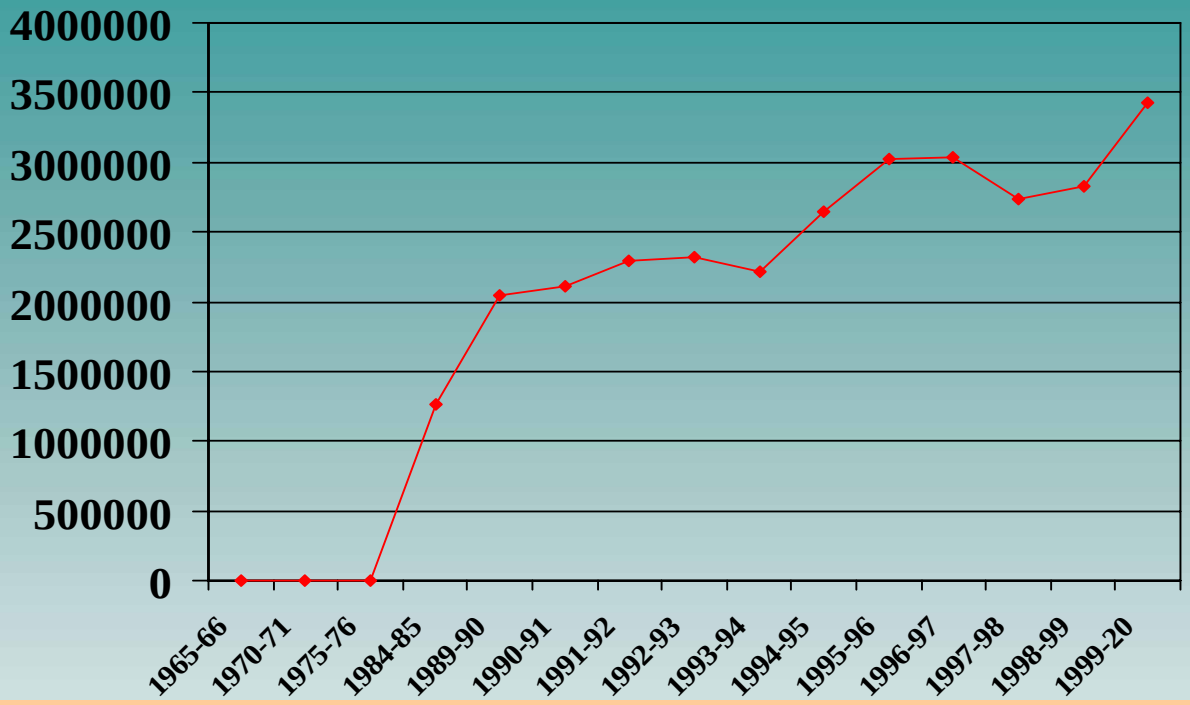


- WASTE GENERATION RAPIDLY INCREASING
- CITY AUTHORITY CANNOT COPE WITH THE SITUATION
- LACK OF SOURCE SEPARATION
- INADEQUATE WASTE COLLECTION
- SHORTAGE OF LAND FOR WASTE DISPOSAL
- POLLUTING SURFACE AND GROUND WATER
- ORGANIC WASTE IS LEFT UNUTILIZED
- LACK OF AWARNESS AMONG CITIZENS
- LACK OF PARTNERSHIP BETWEEN STAKEHOLDERS
- EMISSION OF GREEN HOUSE GAS

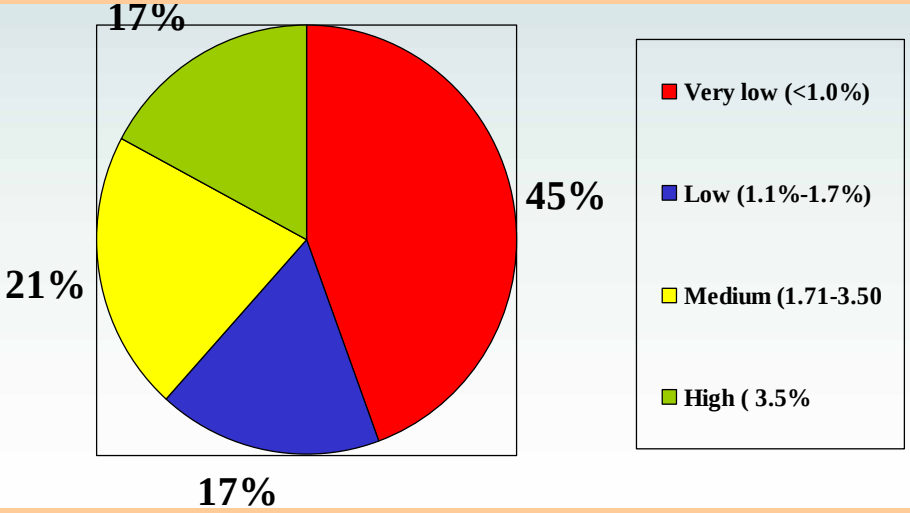
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# SOIL CONDITION OF BANGLADESH

## *REDUCES THE HARMFUL EFFECTS OF CHEMICAL FERTILIZER*




Graph Showing the Increase of Chemical Fertilizer Consumption in Bangladesh




**83% of cultivable land in Bangladesh has less than 3.5% organic matter (more than 3.5% is considered to be good soil)**

Pie Diagram Showing Depletion of Organic Matter From the Soil of Bangladesh

# Waste Concern's Believes …

*`Waste is merely raw material in the wrong place',* (Talbot, 1920). Eighty six years ago, Fedrick A. Talbot in his book, Millions from Waste wrote this line.



ENVIRONMENTAL AND HEALTH PROBLEMS IN URBAN AREAS DUE TO UNMANAGED WASTE

**ADDRESSING TWO MAJOR PROBLMS**

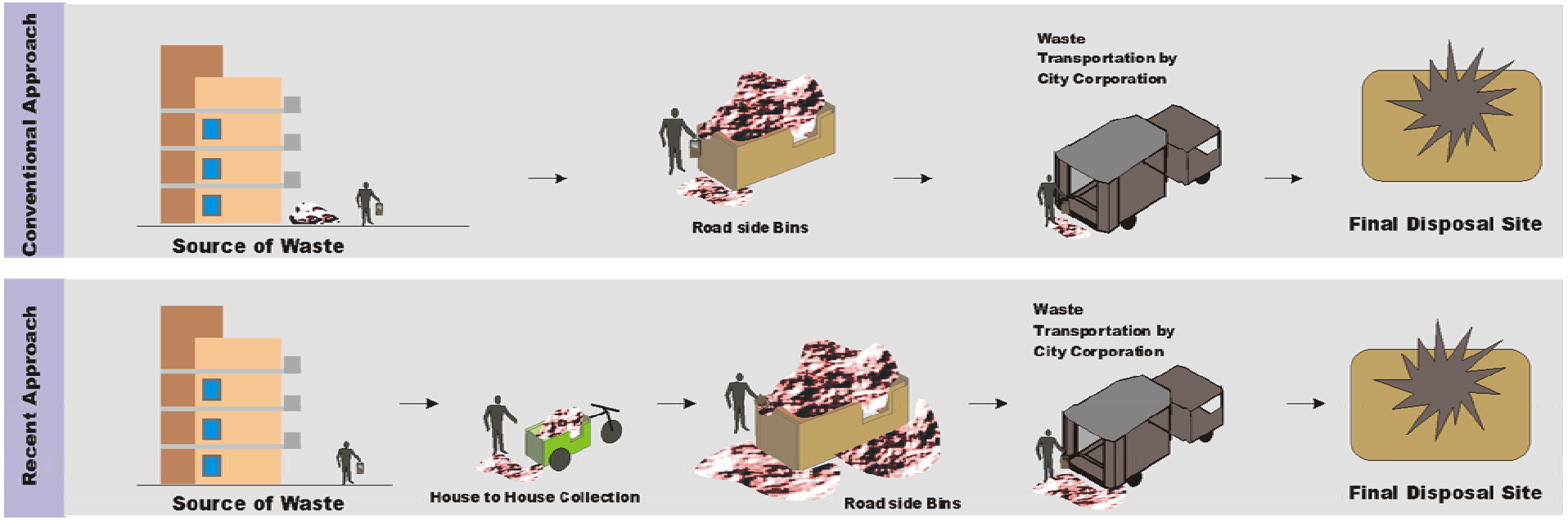


ORGANIC MATTER DEPLETION IN THE SOIL OF RURAL AREAS

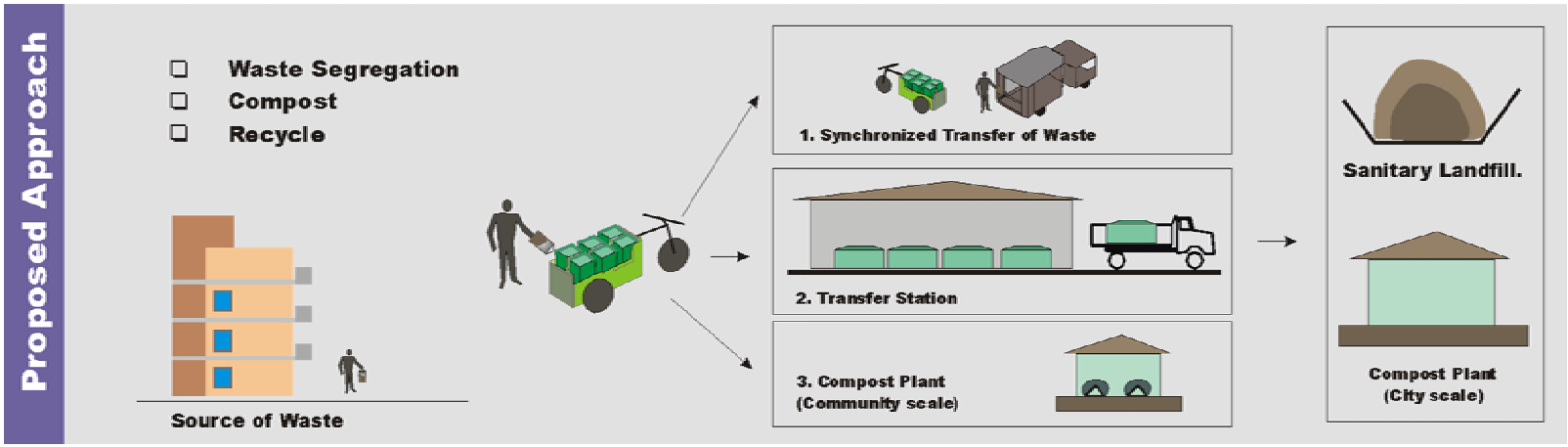
## SOLUTION

- ❑ Converting Organic Waste Into Compost Using Community Based Decentralized Approach Integrated with House to House Waste Collection
- ❑ Use of Compost/Enriched Compost in Agriculture

# Conventional End-of-Pipe Solution of Solid Waste Management




# Approach of Waste Concern Based on 3R Principle




Less requirement for Disposal Site

•Training,
•Awareness Raising
•Promotion of 4Rs

→

•House to House Waste Collection

→

•Decentralized Composting Community Scale/ City Scale

→

•Marketing of Compost
•Promotion of Organic Farming

# Composting Methods Used by Waste Concern

**Barrel Type Composting**



**Aerator Type Composting**



**Box Type Compost**



**Major Advantage Using Waste Concern's Methods are:**

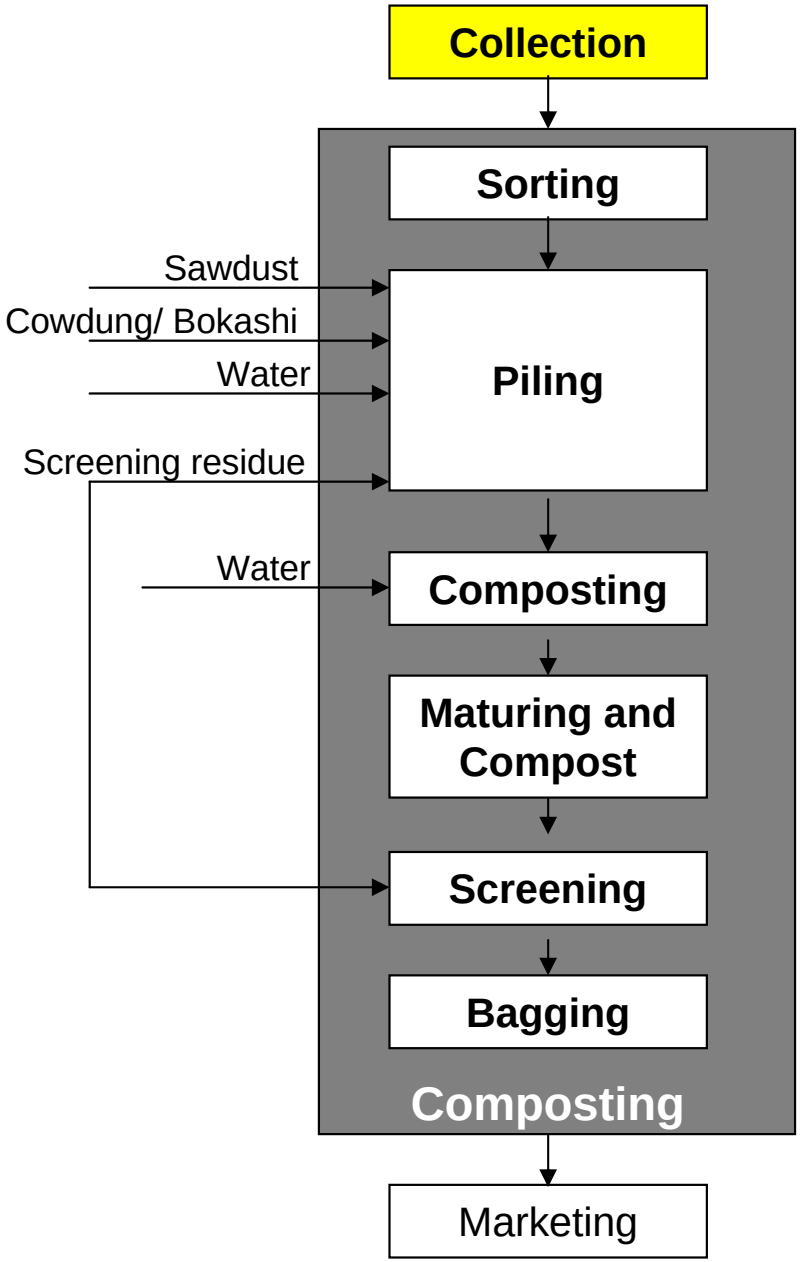
- **Simple, affordable, labor intensive, low cost**
- **Suitable to our socio-economic and climatic condition**




Community Based Urban Solid Waste Management in Dhaka (component 3.3.2)
**Implementing Agency:** Ministry of Environment & Forest
**Sub-Implementing Agency:** Waste Concern
**Supported by:** UNDP

# Community Based Composting

# Different Steps of Composting Process



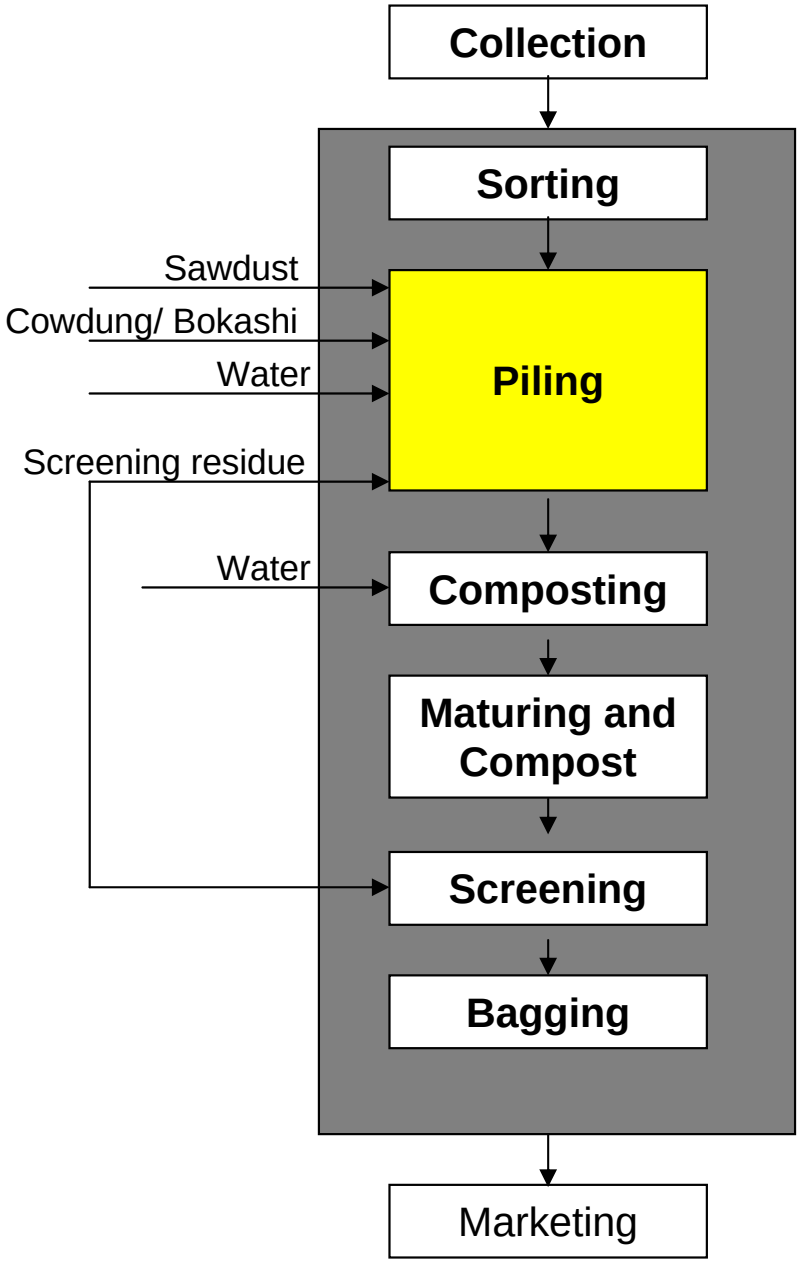

## For a 3 ton/day capacity plant

- 6 Workers for Collection waste (mainly men)
- 10 workers for Composting Process (mainly women)
- Daily House-to-house Collection
- 1430 households
- Capacity of Rickshaw Van= 1.18 m3

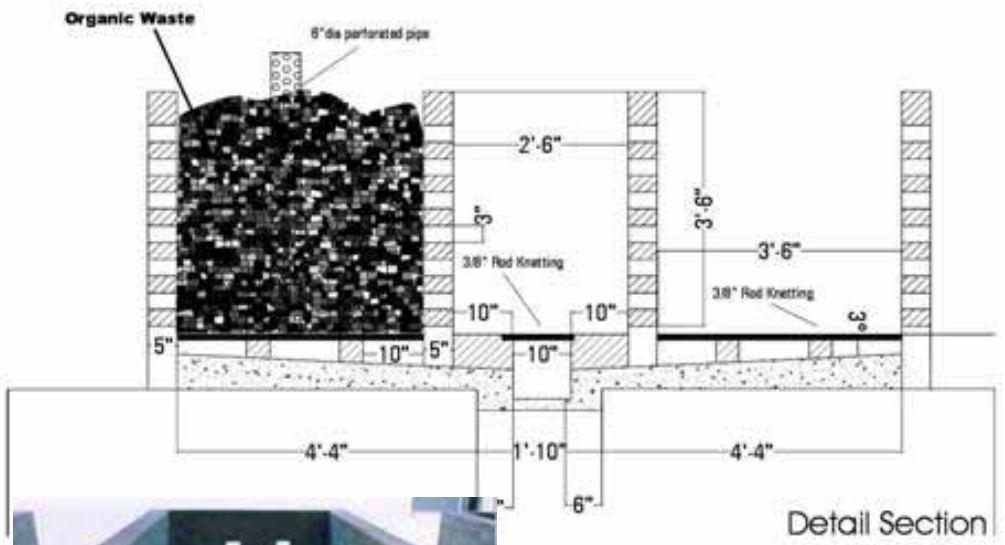


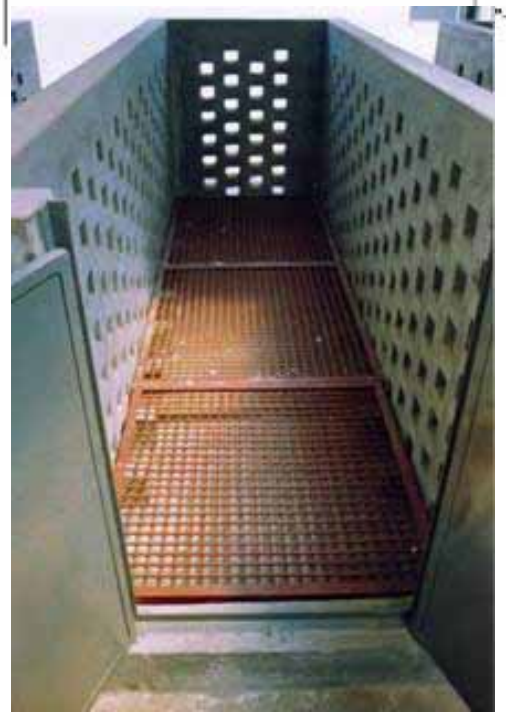
## Collection

# Different Steps of Composting Process




## Box Method

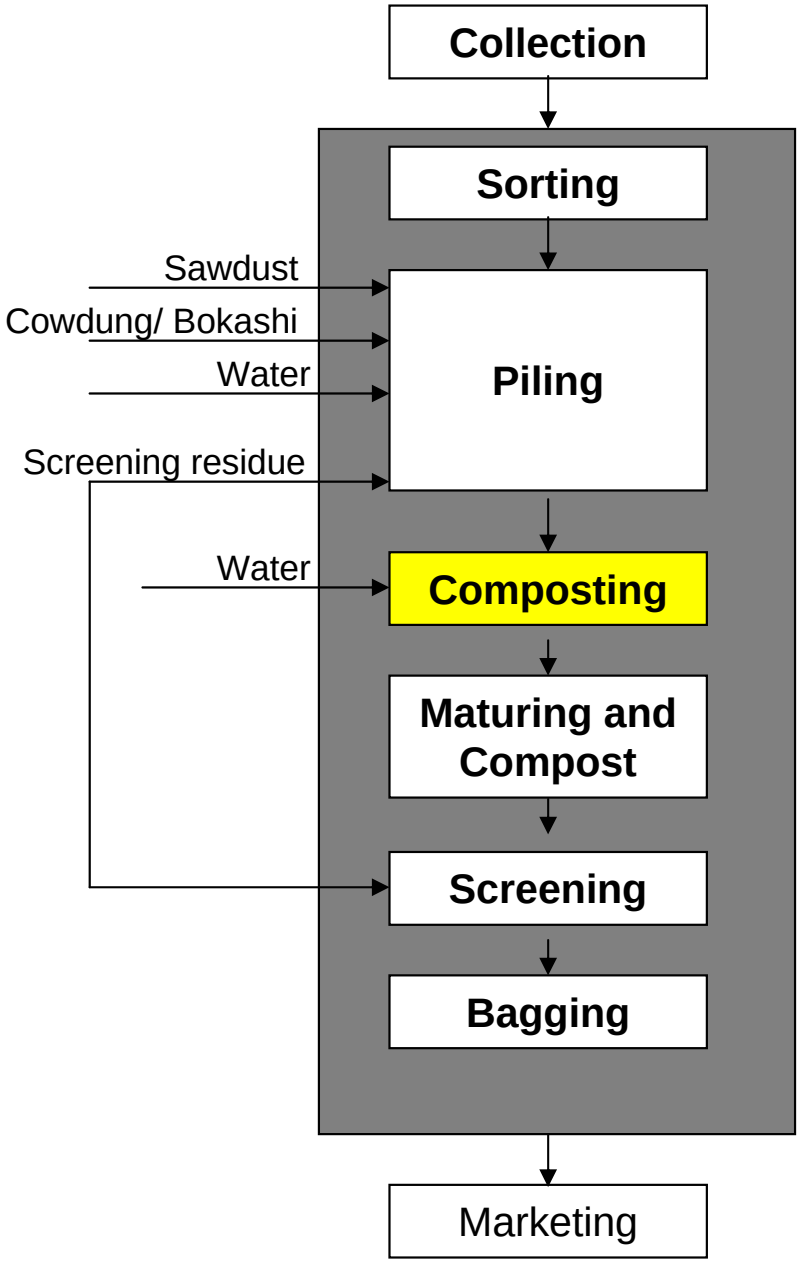


- Use of additives for optimizing Process
- Roof Covered Concrete Slab
- Bamboo Aerator/ perforated brick box
- Low cost technique
- Labor intensive

## Composting

# Different Steps of Composting Process




**Aerator Method**

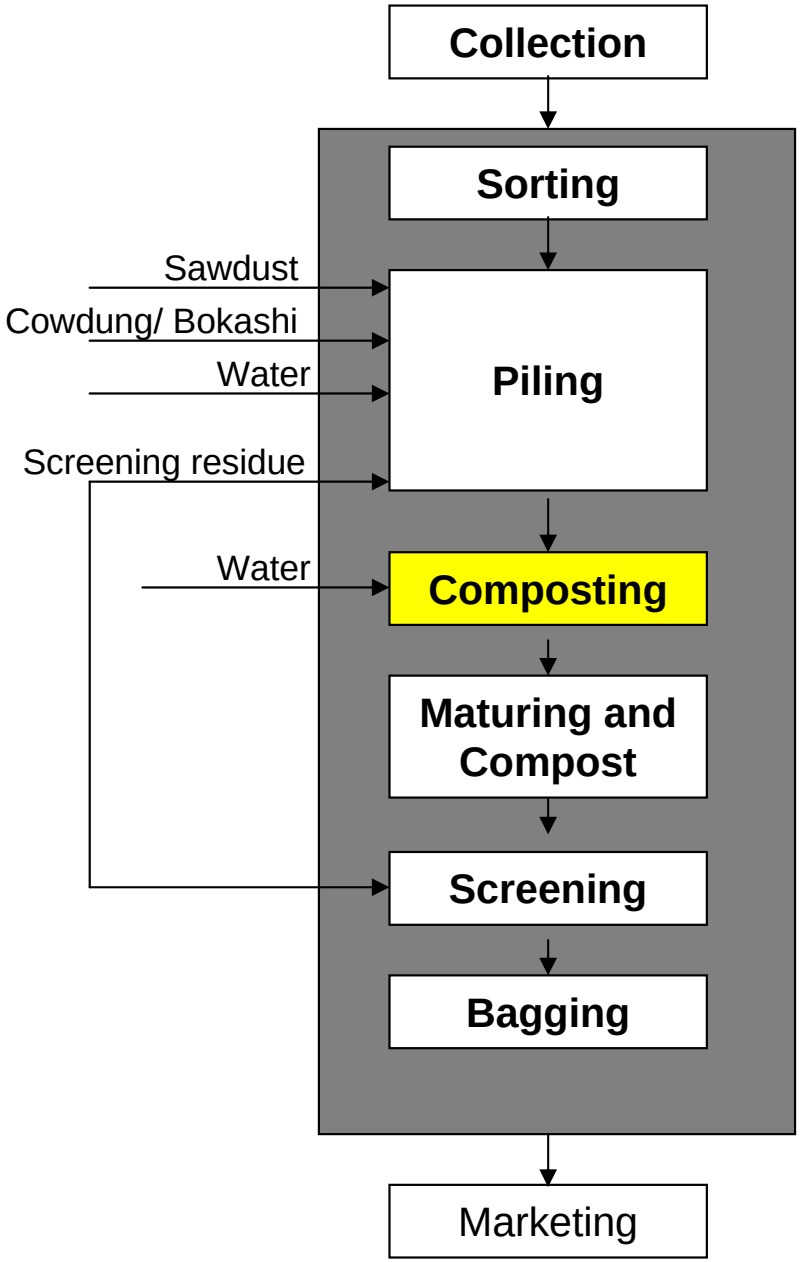


**Box Method**



## Composting

# Different Steps of Composting Process




## TEMPARATURE CONTROL

**Thermophilic Phase (40-70º C)**
Takes 27 days
**Mesophilic Phase & Maturation (20-40º C)**
11 + 15 days
-Temperature is monitored and records are kept to assess the trends



## Composting

# Survival Time (in days) of Pathogen by Different Treatment Method

| Types of Treatment | Bacteria | Virus | Protozoa | Helminths |
|---|---|---|---|---|
| Night soil, faeces at 20-30 C | 90 days | 175 days | 10 days | Many months |
| Composting (anaerobic) septic tank/ pit latrine | 60 days | 60 days | 30 days | Many months |
| Thermophilic Composting 50-60$^0$C | 7 days | 7 days | 7 days | 7 days |
| Waste Stabilization Pond Retention time >20days | 20 days | 20 days | 20 days | 20 days |

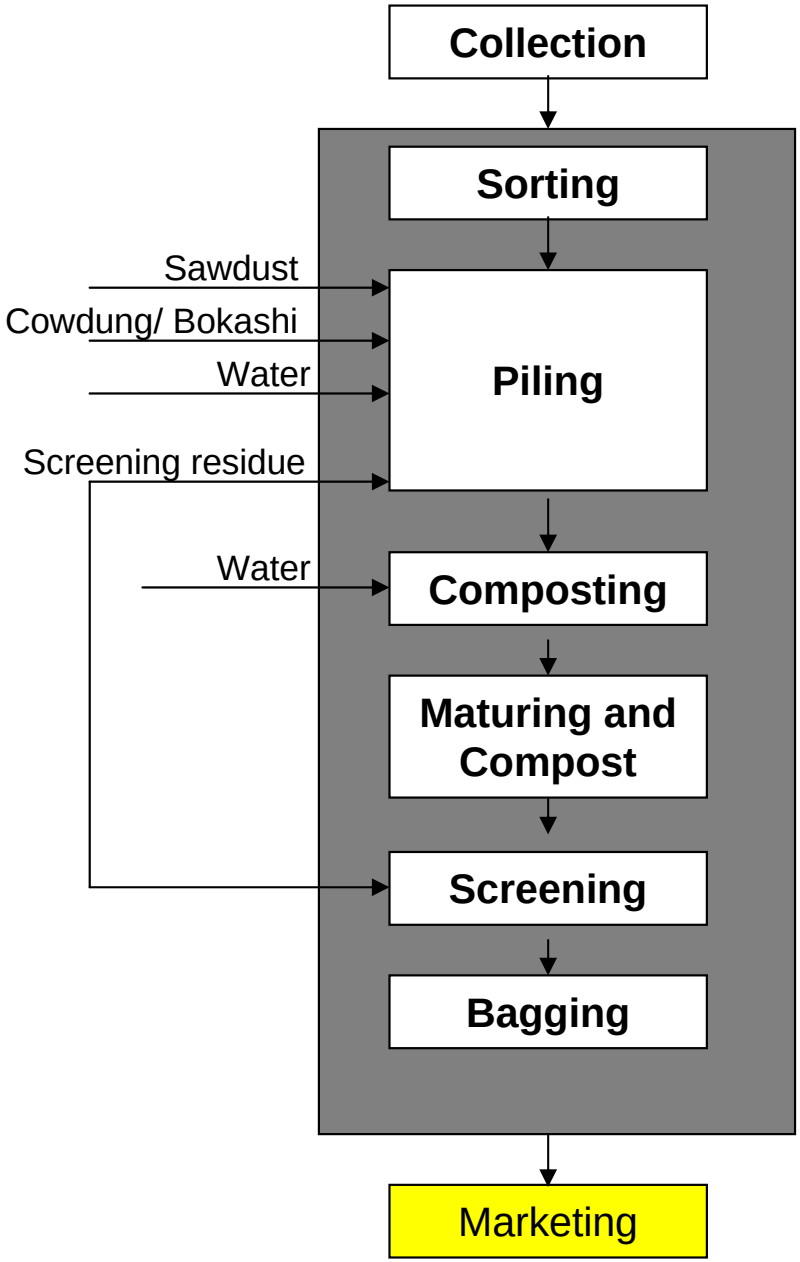
Source: IDA (1990)






## Screening and Bagging

# Different Steps of Composting Process




**BAGGING**

- 40 kg bags





## Marketing

# IMPACT OF THE PROJECT

**1 ton**
Organic Waste

**Composting**



**1/4 ton**
**Compost**

# MARKETING OF COMPOST BY PRIVATE SECTOR







## Innovation……..

**Marketing of nutrient enriched compost ( compost blended with fertilizers)**

**FERTILIZER COMPANY**

-Grinding
-Enriching
-Screening
-Distribution through own retail channels
-Directly to Farmers and nurseries
-Own use for demonstration plot



**Compost (8mm)**

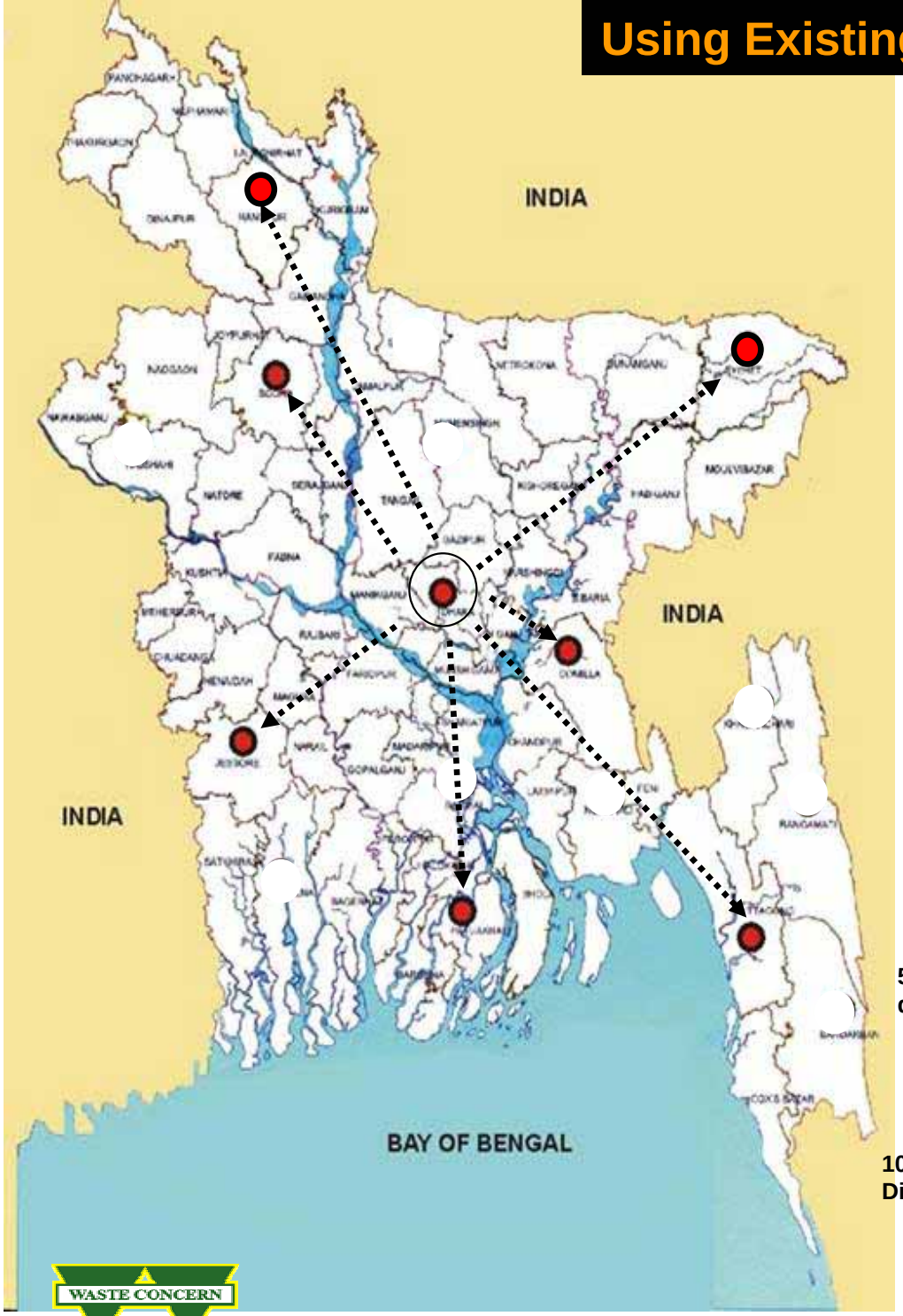


**Compost (4mm)**



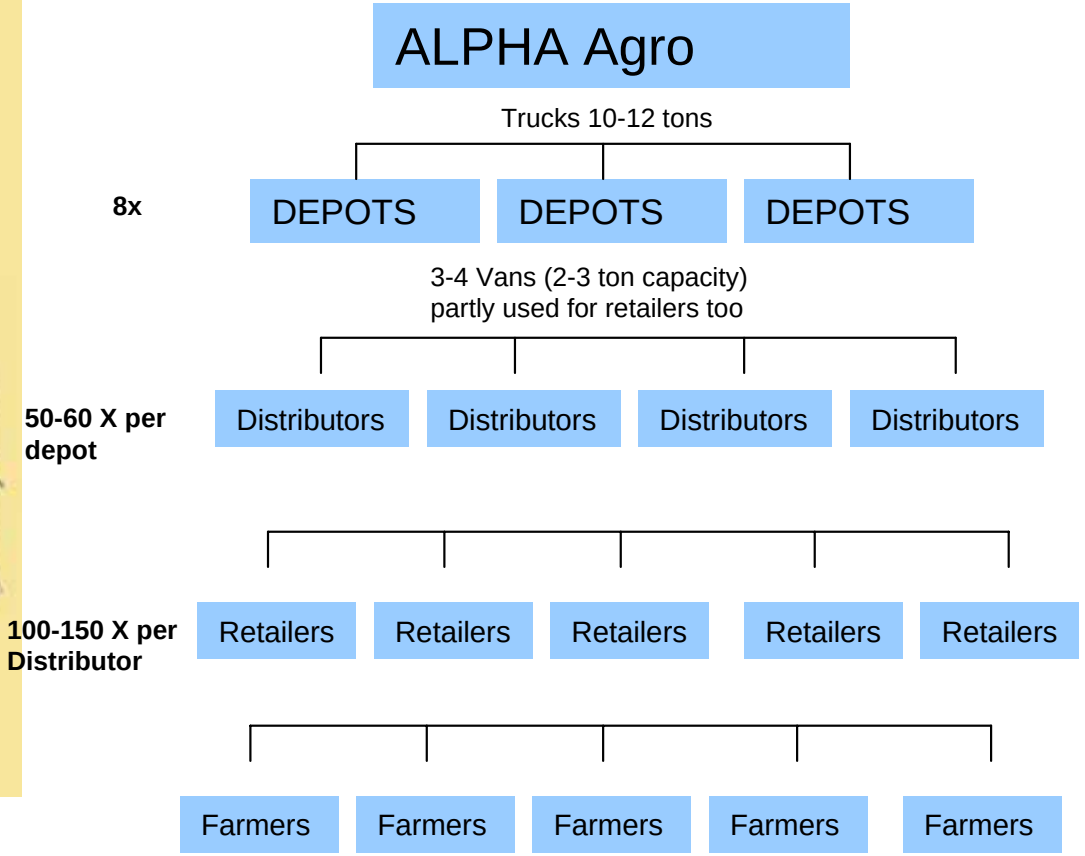
**Enriched & Granular**

# Using Existing Country-wide Marketing Network

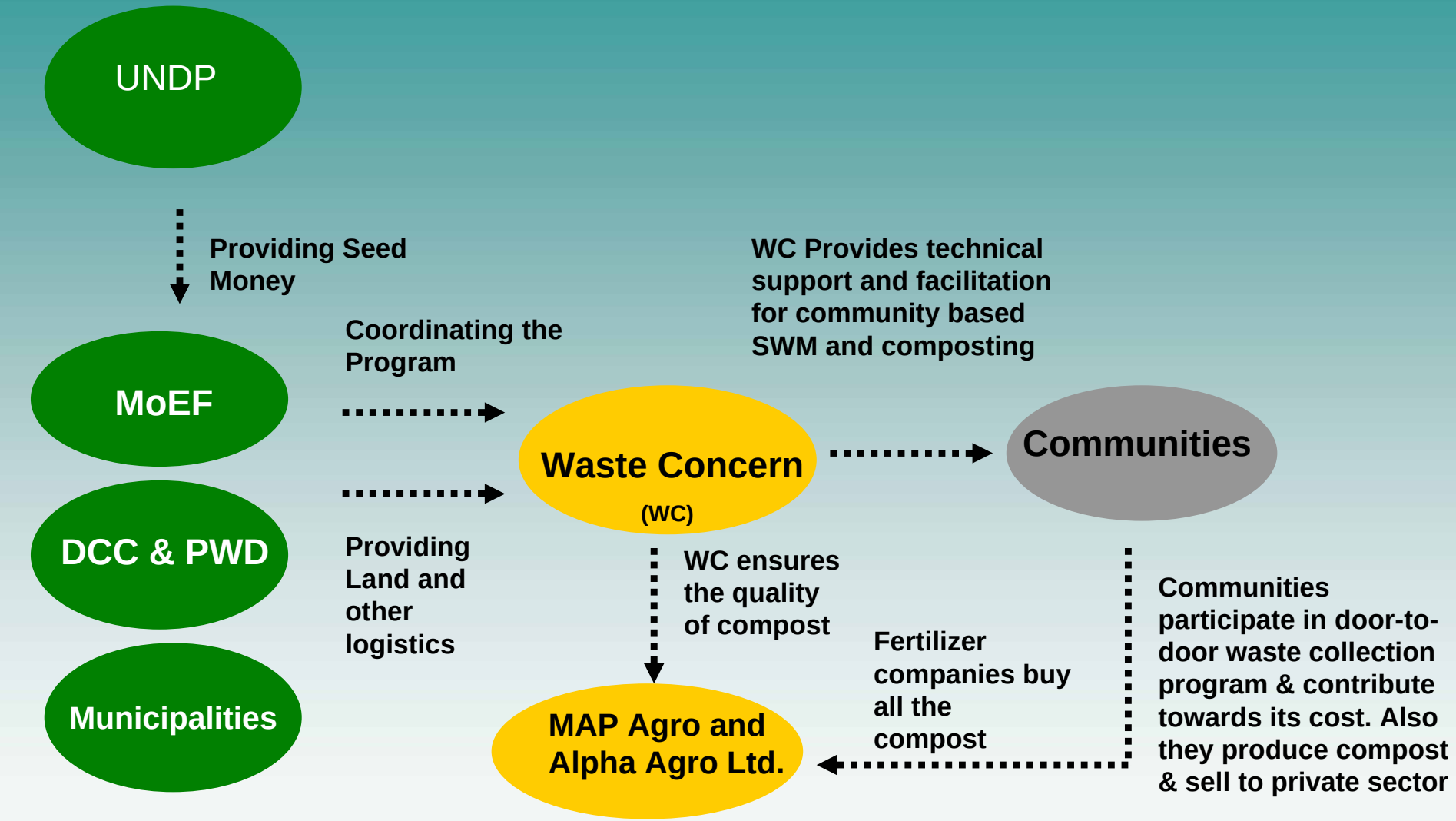





Existing Storage and Formulation Facility of ALPHA Agro Ltd. at Gazipur, Dhaka



# PARTNERSHIP MODEL OF COMMUNITY BASED COMPOSTING UNDER SEMP



# IMPACT OF THE PROJECT

- ❑ Communities are Cleaner and Healthier
- ❑ Communities are Participating and Have Ownership of The Project
- ❑ Saves Money and Landfill Area for Local Authorities
- ❑ Promotes Sustainable Farming



**Beneficiary from the project in 38 replication in 20 towns of Bangladesh:**

**Total Beneficiary:**

**60,000**
(directly from Waste Concern's project)

**2,72,500**
**(**from replications by others)

**Excluding Farmers**



**BEFORE Intervention**



**AFTER Intervention**

# IMPACT OF THE PROJECT

## *GENERATES EMPLOYMENT FOR THE URBAN POOR*









- Helping the destitute and hardcore people for new employment
- Integrates informal labor for the production of compost
- Reduce the number of waste pickers near the dustbins & landfill sites
- 16,000 new employment can be created for the urban poor of Dhaka City and 90,000 for country

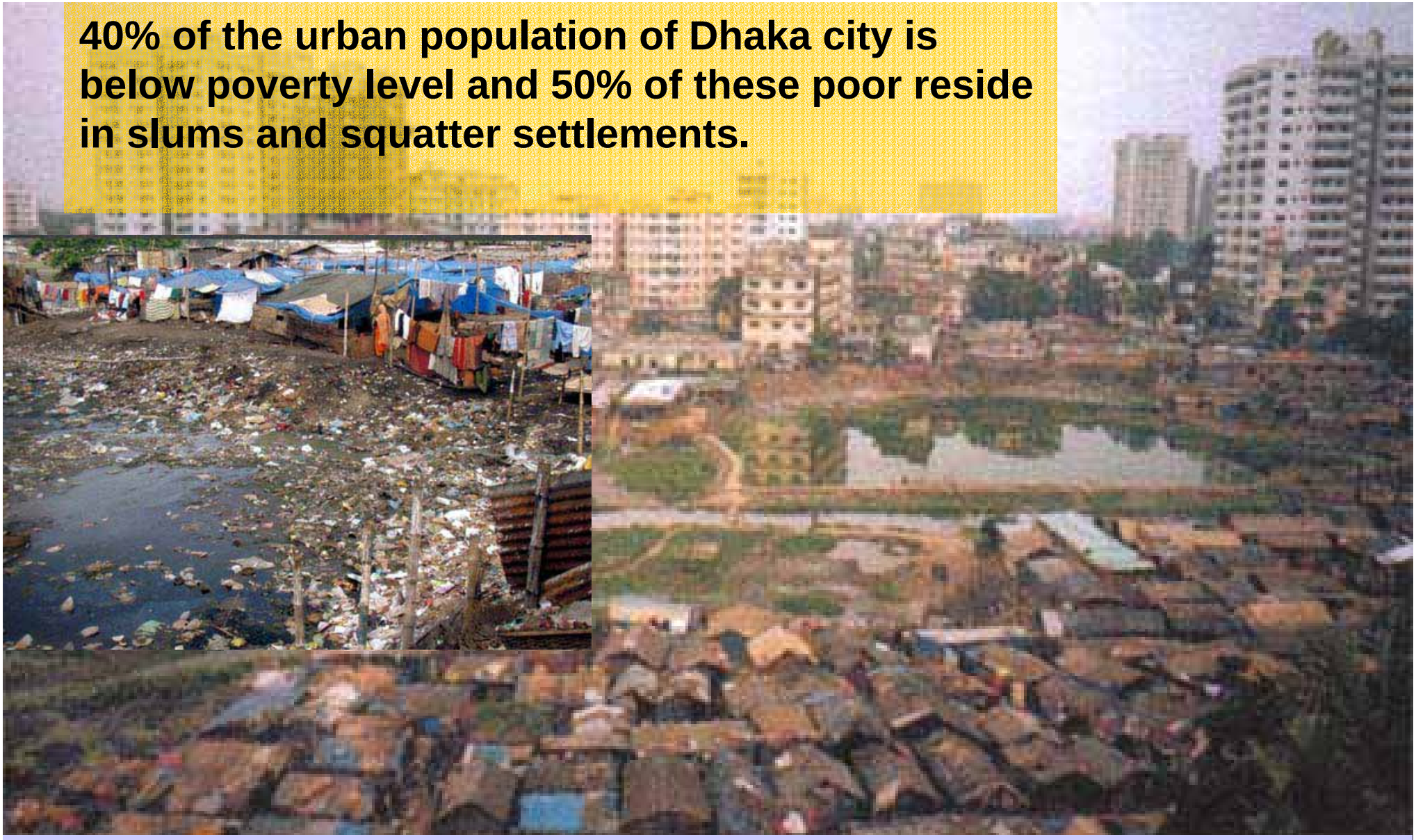
# Cost Recovery/ Sustainability of Community Based Model

- The project is financially viable
- Fixed cost of 3 ton capacity plant is US $ 8800
- Operational cost per year is US $ 10200
- Per year income from the project is US $ 14,800
- 70% is the income from sale proceeds of compost
- 30% is the income from charges for house-to-house waste collection
- Pay back period of the investment is 23 months

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# Barrel Type Composting

**40% of the urban population of Dhaka city is below poverty level and 50% of these poor reside in slums and squatter settlements.**



- **Introduction of `Barrel Type' composting system**
- **Build awareness, provide training and create income opportunities from compost for the slum dwellers**

Using Public-Private-Community Partnership Approach being replicated in several slums of Dhaka and other communities outside Dhaka city





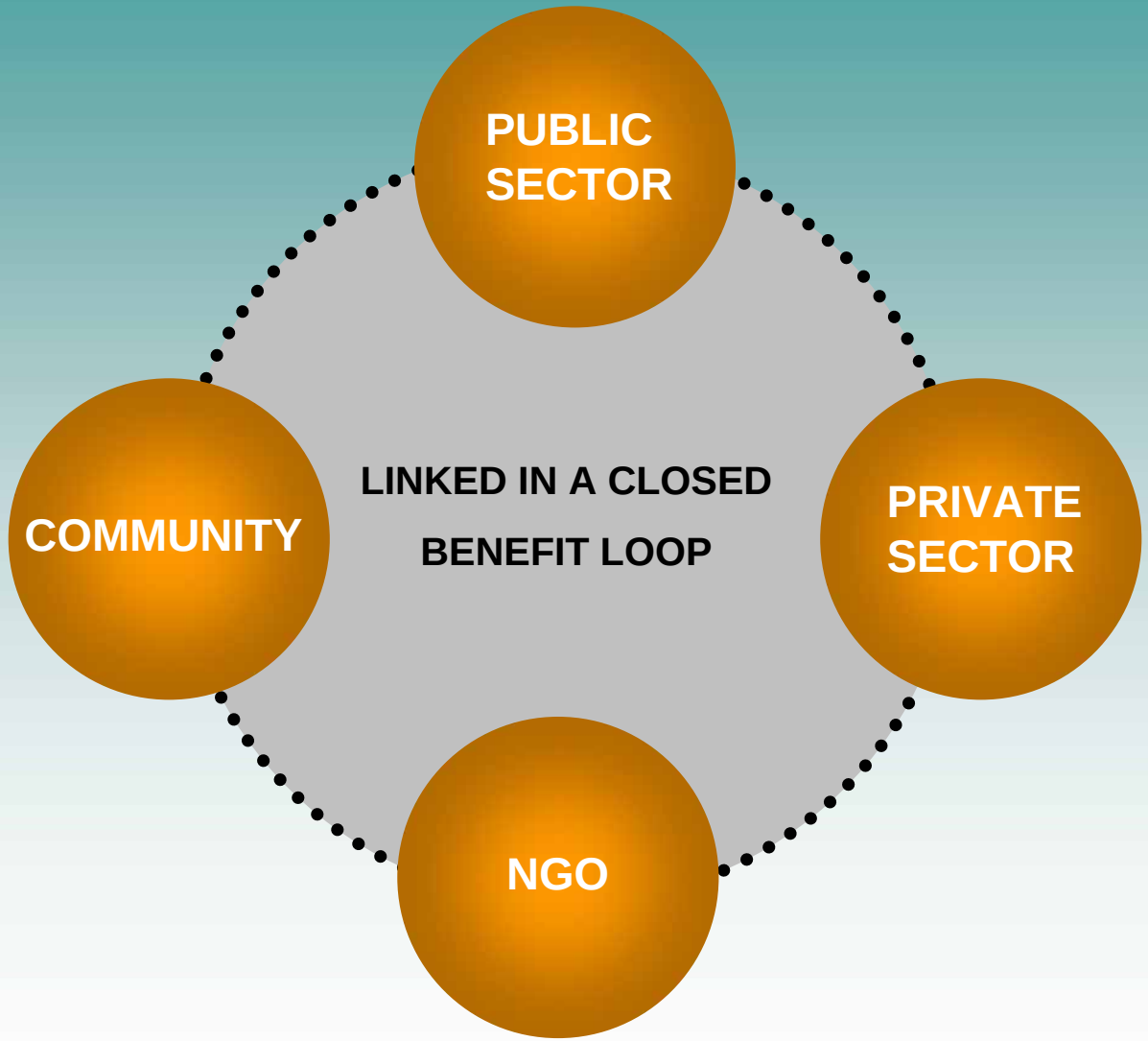
- Significantly Reduced Littering of Waste
- Improved the solid waste and health problems of the slum

# Barrel Type Composting in the Slums

# Salient Feature of the Project

- One green barrel (for organic waste) is provided for a group of 5-6 Nos. of households and placed on a raised base with concrete ring.
- Specially designed 200 liter bottomless perforated steel/ plastic barrel with a lid used for this system.
- Semi Aerobic Composting Technique is followed in Barrel System. Within three months time period compost is produced.
- Yellow barrels used for disposal of inorganic waste.
- The households sharing the income from sale proceeds of the compost.
- Cost of a compost barrel is around US $ 20
- Compost worth between US $ 10-11 can be produced each year
- Cost recovery 23 months

# PROFITS FOR ALL STAKEHOLDERS CAN BE A KEY TO SUSTAINABLE WASTE MANAGEMENT SERVICES




WASTE CONCERN

## Public Sector: No Partnership

**PROBLEMS**

**55% Collected**

**55%** Disposed

Collected by Municipalities

**Waste** → **Community Bin** → Dumped in Crude Dump Site

- ✓Water Pollution
- ✓Spread of Disease Vectors
- ✓Green House Gas Emission
- ✓Odor Pollution
- ✓More Land Required for Landfill

45% remains uncollected

Land Required: 273 acre/ year

Cost Per Ton : US $ 6 to US $ 30

# Existing Practice

*Conventional end-of-pipe solution (based on collection-transportation-disposal)*

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**100% Collected**

House-to-house waste collection method

**86% Recycled**

**Waste** → Composting Plants small-medium-large

- 70%-80% **Composted** → Agriculture
- 6% **Recyclables** → Local market
- 14% **Non-compostable** → Landfilled
- GHG Reduced → CER

Full cost recovery

Community paying for the house-to-house collection

Community involved with the activity

Municipalities are saving cost of managing waste.

Govt./ Public Agencies Providing land Private sector purchasing land

Operated by Community/NGOs/ Private Sector

Price of Compost: US$ 45/ ton

Marketing of compost & recyclable done by private companies

## Decentralized Approach: Based on Partnerships

# Growth Over Time and Barrier Faced

- Lack of technology
- Lack of finance
- Lack of awareness
- Lack of partnership

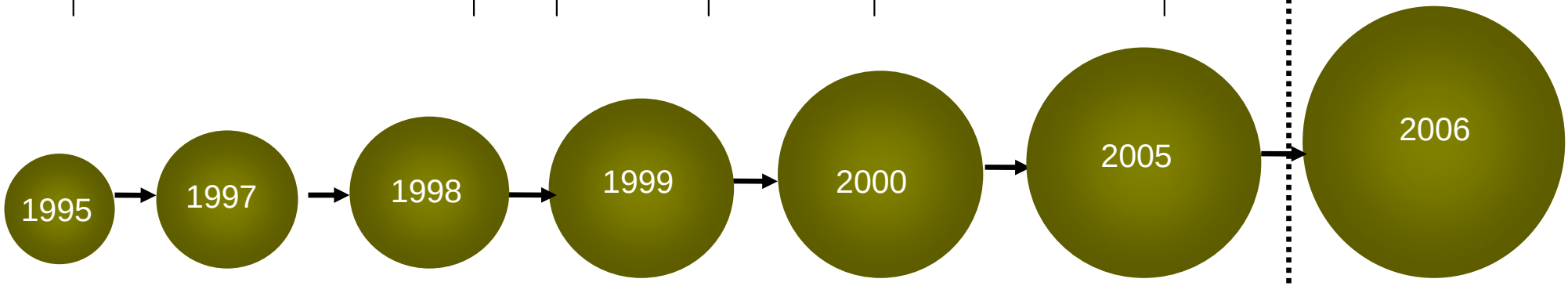
- Land for composting provided by Government
- Policy change
- Majority Grant from GoB & External Agencies for Piloting and some private investments

Land and waste collection by private sector

small and medium scale

Large scale

**Demonstration** | **Partnership** | **Replication** | **Scaling-up**




Waste Concern starts pilot community based resource recovery project in Dhaka

Regional Urban Development Office (RUDO)-South Asia supports to increase the capacity of the project and to further test the model

With support from MoEF, UNDP, Waste Concern under SEMP selected to replicate the model in 5 (five) communities of Dhaka City

Partnership agreement signed between public-private sector-community to implement the project

Replication of the model in Dhaka, Khulna & Sylhet cities.

38 replications of this model in more than 20 cities/ towns of Bangladesh

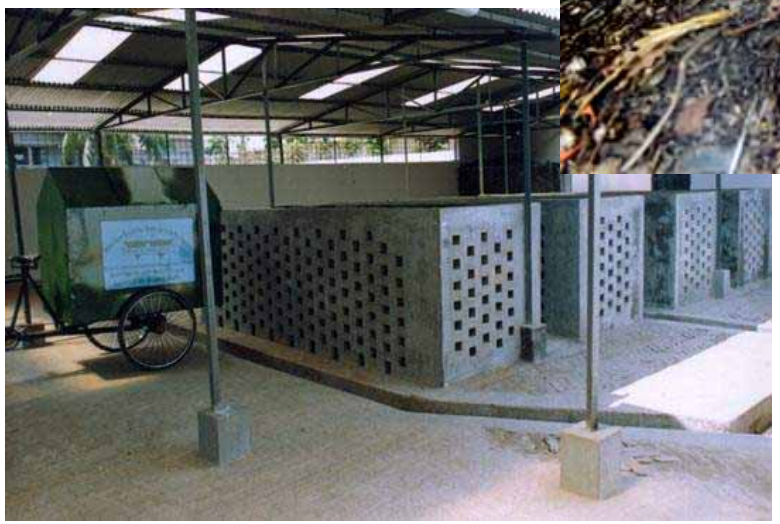
Regional replication in other Asian countries (Vietnam, Sri Lanka).

700 Tons/ day capacity Decentralized large scale Composting project under CDM located in suitable locations of Dhaka city

# Replication in 20 cities and Towns of Bangladesh








WASTE CONCERN

# Replication in 20 cities and Towns of Bangladesh



Rangamati,Chittagong Hill Tract




Barisal




Patuakhali



Jessore

WASTE CONCERN

# Replication in 20 cities and Towns of Bangladesh













WASTE CONCERN

# Replication in 20 cities and Towns of Bangladesh













# Replication in Rural Areas of Bangladesh










# Recycling Training Center (RTC), Dhaka




**To promote idea of *converting waste into resource***

**A regional recycling training center has been established with the support from UNDP under the Sustainable Environment Management Program (SEMP) for Technology Demonstration and Hands-on training.**

# Regional Recycling Training Center, Dhaka

**This training center consists:**

**TRAINING CENCER: For 30 participants/batch**

**TECHOLOGY DEMONSTRATION:**

- **8 (eight) tons capacity composting plant**
- **Waste Water Treatment**
- **Eco-toilet**
- **Rain water harvesting**
- **Energy efficiency**
- **Training Room Facility**
- **Compost Enrichment Facility**

❑ **A Handbook on Decentralized Composting has been developed to help others to carryout waste to resource activities. This handbook jointly prepared by Waste Concern and SANDEC with the support from UNDP, SDC under SEMP**







# Global Impact



# 3R Principal for Solid Waste Reflected in the National and Local Government Policies and Plan

## POLICY

- **National Policy for Water Supply and Sanitation, 1998**
  According to this policy the government shall take measures for recycling of waste as much as possible and use organic waste materials for compost and bio-gas production;
- **Draft National Urban Policy- 2006**
  CDM and Recycling has been emphasized in this policy

## RULES

- **Lead Acid Battery Recycling and Management Rules, 2006**: Under this rules collection and recycling has been improved. This rules is based on a detail study carried out by Waste Concern on 2005 under SEMP.
- **Draft National Solid Waste Management Handling Rules, 2005:** 3R principal has been used. This rule has been prepared by Waste Concern under SEMP.

## STRATEGY

- **Poverty Reduction Strategy Paper (PRSP) 2005:** Here EMS has been promoted. To improve the solid waste management situation, special focus is given to segregation of waste at source along with the promotion of recycle, reduce and reuse of industrial and other solid waste etc.
- **National Sanitation Strategy 2005:** Its goal is to achieve 100% sanitation coverage by 2010. Here emphasis on resource recovery and recycling has been given as top priority to improve urban sanitation situation instead of disposal.

## ACTION PLAN

- **Dhaka Environment Management Plant 2005**
  Waste recycling has been promoted, less land filling encouraged, EMS promoted among industries.
- **National Environmental Management Action Plan (NEMAP) (1995):**
  This is a plan of the Government of Bangladesh (GoB), prepared by the Ministry of Environment and Forest (MoEF) in consultation with people from all walks of life. Waste Concern is promoting 3R, under the Sustainable Environment Management Programme (SEMP) of NEMAP.
- **Solid Waste Management Action Plan for Eight Secondary Towns in Bangladesh (2005):** Under the Secondary Towns Integrated Flood Protection (Phase-2) Project of Local Government Engineering Department, GoB. This strategy is based on based on 4 R principle i.e. reduce, reuse, recycle and recover of the waste.

## DECLARATION

- **Dhaka Declaration 2004 on Waste Management by SAARC countries during** 10–12 October 2004. SAARC countries agree to encourage NGOs and private companies to establish community based composting, segregation of waste at source, separate collection and resource recovery from wastes with particular focus on composting.

# Solid Waste Management and Sanitation in Eight Secondary Towns in Bangladesh (2005)

Secondary Towns Integrated Flood Protection (Phase-2) Project
Local Government Engineering Department, GoB

**Strategy for Solid Waste Management**

- The present solid waste management practice being followed is based on the end-of-pipe approach, i.e. collect-transport-dispose. This approach is neither sustainable nor cost-effective.
- The strategy for solid waste management is based on 4 R's principle i.e. reduce, reuse, recycle and recovery of the waste.

**Main objectives of this strategy is:**

- Prioritizing waste avoidance over recycling and recycling over the other forms of environmentally sound disposal methods;
- Reuse non-avoidable waste as far as possible;
- Maintain the content of hazardous substances in waste at the lowest possible level;
- Guarantee an environmentally sound waste collection, transportation, resource recovery and disposal system; and
- Promotion of Public-Private-Community Partnerships in solid waste management